CLAIMS

What is claimed is:

1. A electrochemical device, comprising: an electrolyte including a cyclic polysiloxane having one or more side chains that each include a poly(alkylene oxide) moiety and a spacer positioned between the poly(alkylene oxide) moiety and a silicon on a main chain of the polysiloxane.

2. The device of claim 1, wherein the spacer includes one or more carbons.

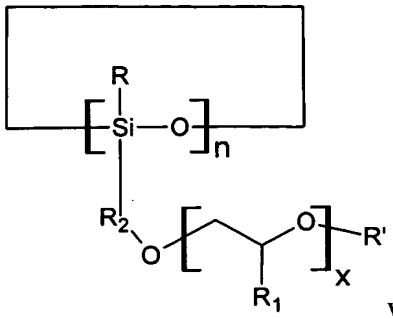
3. The device of claim 1, wherein the spacer includes one or more CH_2 groups.

4. The device of claim 1, wherein the spacer includes 2 or more CH_2 groups.

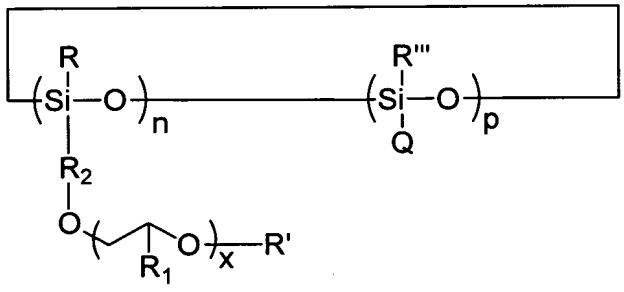
5. The device of claim 1, wherein the spacer includes 6 or fewer CH_2 groups.

6. The device of claim 1, wherein the poly(alkylene oxide) moiety includes a poly(ethylene oxide) moiety.

7. The device of claim 1, wherein the cyclic polysiloxane is cross-linked.

8. The device of claim 1, wherein the polysiloxane has a structure represented by the formula:  wherein R is an alkyl or aryl group; R' is an alkyl or aryl group; R_1 is hydrogen or an alkyl group; R_2 is a spacer made up of one or more CH_2 groups; n is from 1 to 100; and x is from 1 to 30.

9. The device of claim 8, wherein the electrolyte is a liquid.

10. The device of claim 1, wherein the polysiloxane has a structure represented by the formula:  wherein R is an alkyl group, R' is an alkyl or aryl group, R''' is alkyl or hydrogen; R_1 is hydrogen or an alkyl group; R_2 is a spacer made up of one or more CH_2 groups; p is greater than 0; n is from 1 to 100; x is from 1 to 30; and Q is a cross-linker linking the polysiloxane to another polysiloxane.

11. The device of claim 10, wherein the electrolyte is a solid.

12. The device of claim 10, wherein at least a portion of the cross-linkers include a moiety selected from the group consisting of $O\text{-}(CH_2CH_2O)_q$ and $Si\text{-}O\text{-}(Si\text{-}O)_k\text{-}Si$, where q is at least 4 and less than 30, and k is at least 5 and less than 30.

13. The device of claim 1, wherein the electrolyte and further includes:

at least one alkali metal salt.

14. The device of claim 13, wherein the alkali metal salt is selected from a group consisting of: $LiClO_4$, $LiBF_4$, $LiAsF_6$, $LiPF_6$, $LiCF_3SO_3$, $Li(CF_3SO_2)_2N$, $Li(CF_3SO_2)_3C$, $LiN(SO_2C_2F_5)_2)$, lithium alkyl fluorophosphates, lithium bis(chelato)borates, $LiPF_3(C_2F_5)_3$, and $LiPF_3(CF_3)_3$.

15. The device of claim 1, wherein the electrolyte includes a lithium bis(chelato)borate having 5 to 10 membered rings.

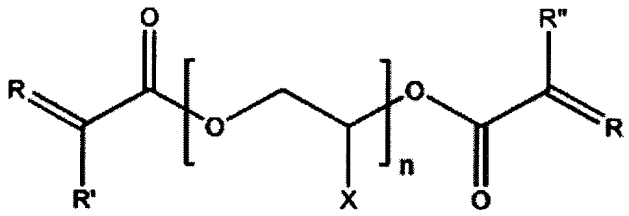
16. The device of claim 1, wherein the electrolyte includes a lithium bis(chelato)borate having 5 to 7 membered rings.

17. The device of claim 1, wherein the cyclic polysiloxane is entrapped within at least one cross-linked network polymer.

18. The device of claim 17, wherein the electrolyte is a solid.

19. The device of claim 17, wherein the at least one network polymer includes a poly(methacrylate).

20. The device of claim 17, wherein the network polymer is formed from a monomer represented by general formula:



wherein R is an alkyl group having 1 to 10 carbon atoms; each of R' and R" is selected from the group consisting of: hydrogen, an alkyl group having 1 to 10 carbon atoms, and an alkenyl group having 2 to 12 carbon atoms; X is hydrogen or a methyl group; and n is 1 to 15.

21. The device of claim 17, wherein the network polymer includes a cross-linked polysiloxane.

22. The device of claim 17, wherein the network polymer includes a polysiloxane where at least a portion of the main chain silicons are linked to side chains that each include a poly(alkylene oxide) moiety.

23. The device of claim 22, wherein at least a portion of the main chain silicons are bonded to a cross-linker having a moiety selected from the group consisting of:

$O\text{-}(CH_2CH_2O)_q$ and $Si\text{-}O\text{-}(Si\text{-}O)_k\text{-}Si$, where q is at least 4 and less than 30, and k is at least 5 and less than 30.

24. The device of claim 22, wherein n of the main chain silicons are bonded to a cross-linker and m of the main chain silicons bonded to a side chain, a ratio of n:m being in a range of 1:4 to 1:200.

25. The device of claim 24, wherein the ratio of n:m is in a range of 1:6 to 1:100.

26. The device of claim 1, wherein the electrolyte further includes:

at least one solid polymer.

27. The device of claim 26, wherein the at least one solid polymer is selected from the group consisting of: polyacrylonitrile (PAN), poly(methyl methacrylate) (PMMA), poly(vinylidene fluoride) (PVdF), poly(vinylidene fluoride-co-hexafluoropropylene), poly(vinyl acetate), polystyrene, and poly(ethylene oxide) (PEO).

28. The device of claim 1, wherein the average molecular weight of the cyclic polysiloxane is less than or equal to 20,000 g/mol.

29. The device of claim 1, wherein the dynamic viscosity of the cyclic polysiloxane is less than or equal to 10,000 cps.

30. The device of claim 1, wherein the molar ratio of [EO]/[Li] is 5 to 50.

31. The device of claim 1, further comprising:

at least one lithium metal oxide cathode, at least one porous separator, and at least one anode.

32. The device of claim 31, wherein the at least one anode comprises at least one material selected from the group consisting of: carbon and lithium metal.

33. The device of claim 1, wherein the electrolyte includes a blend of polysiloxanes.

34. A method for synthesizing a cyclic polysiloxane, comprising:

mixing a polysiloxane having at least a portion of the main chain silicons bonded to a hydrogen and an allyl terminated side-chain precursor that includes a poly(alkylene oxide) moiety so as to form a cyclic polysiloxane having one or more side chains that each include a poly(alkylene oxide) moiety and a spacer positioned between the poly(alkylene oxide) moiety and a silicon on the main chain of the cyclic polysiloxane.

35. The method of claim 34, wherein the allyl terminated side-chain precursor includes tri(ethyleneglycol) methyl ether.

36. The method of claim 34, further comprising:

mixing a catalyst with the polysiloxane and the side-chain precursor.

37. The method of claim 34, wherein the catalyst includes platinum.

38. The method of claim 34, wherein the catalyst includes (dicyclopentadiene) $PtCl_2$.

39. The method of claim 34, further comprising:

heating the mixture to about 70-75°C

40. The method of claim 34, further comprising:
removing excess monomer and isomers from the mixture; and
removing volatiles.

41. The method of claim 40, wherein removing excess monomer and isomers includes heating to about 120°C in a reduced atmospheric pressure of about 0.1 torr using Kugelrohr distillation.